



Liberty ID-WSF Web Services Framework Overview

Version: 1.1

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Abstract:

This is a *non-normative* document intended to provide an overview of the relevant features of the Liberty ID-WSF specifications. It provides a general introduction to the Liberty ID-WSF framework, and to how it fits with the other layers of the Liberty architecture. The reader is assumed to have some familiarity with SOAP 1.1, WS-Security, SAML, XML, and basic concepts such as namespaces and URIs.

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31 **Contents**

32 1. Introduction 4
33 2. ID-WSF User Experience Example 10
34 3. Liberty Engineering Requirements Summary 16
35 4. Liberty Security Architecture 19
36 5. Liberty Architecture 21
37 References 29

38 1. Introduction

39 1.1. About this document

40 The Internet is now a prime vehicle for personal, business and community interactions. The Liberty Identity Federation
41 Framework (ID-FF) proposed the use of federated network identity to solve the problems of network identity. The
42 Liberty Identity Web Services Framework (ID-WSF) builds upon this foundation and provides a framework for
43 identity-based web services in a federated network identity environment.

44 This document is a *non-normative* overview intended to describe principal features of the Liberty ID-WSF specifica-
45 tions. It provides a general introduction to the Liberty ID-WSF framework, and describes where it fits with the other
46 layers of the Liberty architecture, as well as with other relevant technologies for authentication.

47 Further details of the Liberty ID-WSF may be found in the following normative technical specification documents:
48 ID-WSF Discovery Service ([\[LibertyDisco\]](#)), ID-WSF SOAP Binding ([\[LibertySOAPBinding\]](#)), ID-WSF Security
49 Mechanisms ([\[LibertySecMech\]](#)), ID-WSF Interaction Service ([\[LibertyInteract\]](#)), ID-WSF Client Profiles ([\[Liberty-](#)
50 [ClientProfiles\]](#)), ID-WSF Static Conformance Requirements, and ID-WSF Data Services Template ([\[LibertyDST\]](#)).
51 Definitions for abbreviations and acronyms not immediately defined in this document may be found in the Liberty
52 Technical Glossary documents for Liberty ID-FF and Liberty ID-WSF ([\[LibertyGlossary\]](#)). As this overview is non-
53 normative it does not use terminology "MUST", "MAY", "SHOULD" in a manner consistent with [\[RFC2119\]](#).

54 The goal of this overview is to provide sufficient information for the readers to understand the architecture defined
55 by the ID-WSF framework and the basic usage scenarios defined for use within the framework. The overview also
56 highlights how the ID-WSF interacts with an identity management framework (such as Liberty ID-FF).

57 The audience for this document is technical managers and application developers. The reader is assumed to have
58 some familiarity with SOAP ([\[SOAPv1.1\]](#)[\[SOAPv1.2\]](#)), WS-Security ([\[wss-sms\]](#)), SAML ([\[SAMLCore11\]](#)) and basic
59 concepts such as namespaces and URIs. The ID-WSF specifications draw upon work conducted in OASIS, W3C and
60 IETF. Standards referenced in a normative manner include SAML, WS-Security, HTTP, WSDL 1.1 ([\[WSDLv1.1\]](#)),
61 XML ([\[XML\]](#)), SOAP 1.1, XML-Encryption ([\[xmlenc-core\]](#)), XML-Signature ([\[XMLDsig\]](#)), TLS1.0 ([\[RFC2246\]](#))
62 or SSL3.0 ([\[SSL\]](#)), and WAP.

63 1.2. What is the Liberty Alliance

64 The Liberty Alliance Project represents a broad spectrum of industries united to drive a new level of trust, commerce
65 and communications on the Internet.

66 1.2.1. The Liberty Vision

67 The members of the Liberty Alliance envision a networked world across which individuals and businesses can engage
68 in virtually any transaction without compromising the privacy and security of vital identity information.

69 1.2.2. The Liberty Mission

70 To accomplish its vision, the Liberty Alliance will establish open technical specifications that support a broad range
71 of network identity-based interactions and provide businesses with:

- 72 • A basis for new revenue opportunities that economically leverage their relationships with consumers and business
73 partners and
- 74 • A framework within which the businesses can provide consumers with choice, convenience, and control when
75 using any device connected to the Internet.

76 **1.3. What is Network Identity?**

77 When users interact with services on the Internet, they often tailor the services in some way for their personal use.
78 For example, a user may establish an account with a username and password and/or set some preferences for what
79 information the user wants displayed and how the user wants it displayed. The network identity of each user is the
80 overall global set of these attributes constituting the various accounts.

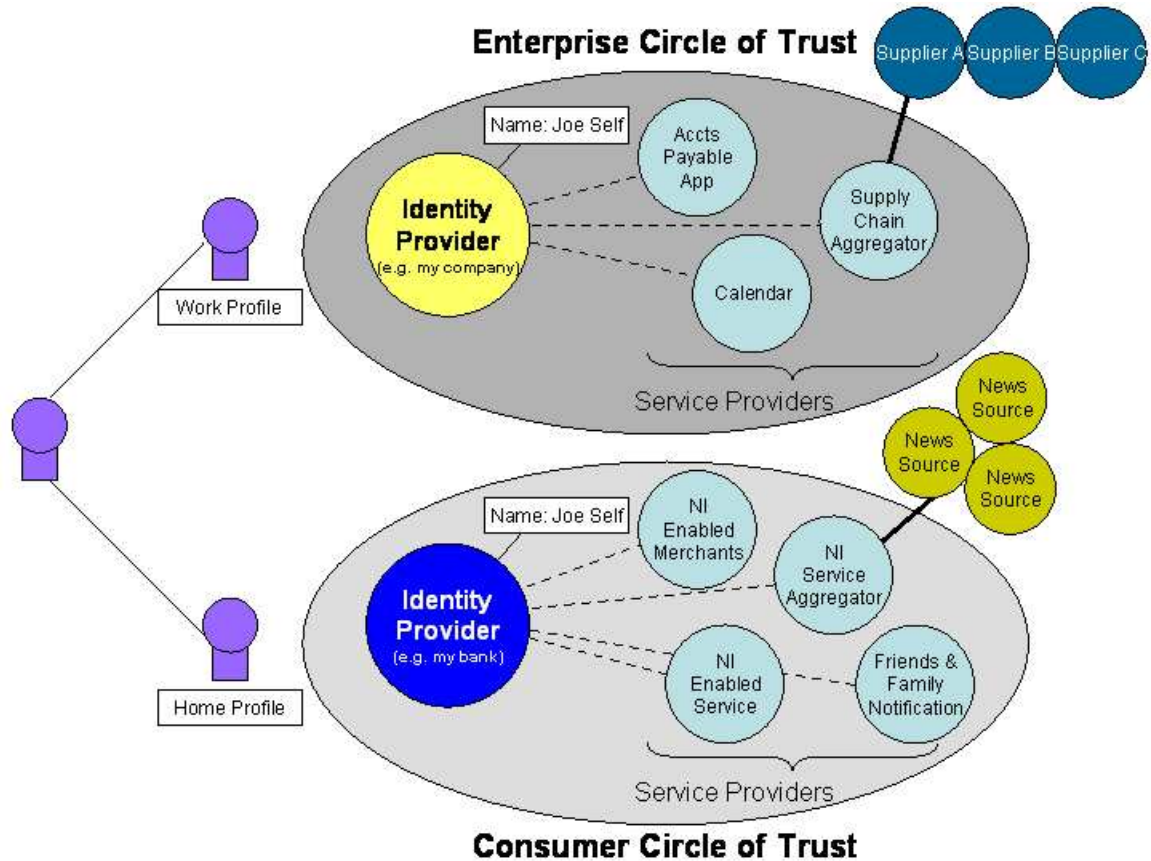
81 Today, users' accounts are scattered across isolated Internet sites. Thus the notion that a user could have a cohesive,
82 tangible network identity is not realized.

83 **1.3.1. The Liberty Objectives**

84 The key objectives of the Liberty Alliance are to

- 85 • Enable consumers to protect the privacy and security of their network identity information
- 86 • Enable businesses to maintain and manage their customer relationships without third-party participation
- 87 • Provide an open single sign-on standard that includes decentralized authentication and authorization from multiple
88 providers
- 89 • Create a network identity infrastructure that supports all current and emerging network access devices

90 These capabilities can be achieved when, first, businesses affiliate together into circles of trust based on Liberty-
91 enabled technology and on operational agreements that define trust relationships between the businesses and, second,
92 users federate the otherwise isolated accounts they have with these businesses (known as their local identities). In other
93 words, a circle of trust is a federation of Service Providers and Identity Providers that have business relationships based
94 on Liberty architecture and operational agreements. Note: Operational agreement definitions are out of the scope of
95 the Liberty ID-FF Version 1.2 specifications. See [Figure 1](#).



96

97

Figure 1. Federated Network Identity and Circles of Trust

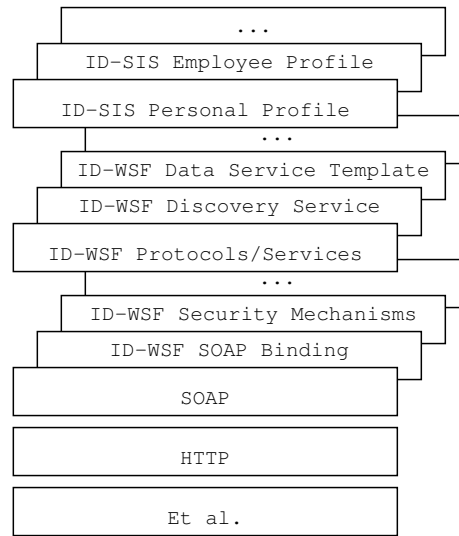
98 From a Liberty perspective, the salient actors in [Figure 1](#) are the user, Service Providers, and Identity Providers.
99 Service Providers are organizations offering Web-based services to users. This broad category includes practically any
100 organization on the Web today, for example, Internet portals, retailers, transportation providers, financial institutions,
101 entertainment companies, not-for-profit organizations, governmental agencies, etc.

102 Identity Providers are Service Providers offering business incentives so that other Service Providers affiliate with them.
103 Establishing such relationships creates the circles of trust shown in [Figure 1](#). For example, in the enterprise circle
104 of trust, the Identity Provider is a company leveraging employee network identities across the enterprise. Another
105 example is the consumer circle of trust, where the user's bank has established business relationships with various
106 other Service Providers allowing the user to wield his/her bank-based network identity with them. Note: A single
107 organization may be both an Identity Provider and a Service Provider, either generally or for a given interaction.

108 Service Providers and Identity Providers enable these scenarios by deploying Liberty-enabled products in their
109 infrastructure, but do not require users to use anything other than today's common Web browser.

110 **1.4. What is the Identity Web Services Framework?**

111 The Liberty Identity Web Services Framework defines a SOAP based invocation framework with a layered architecture.
112 The framework does not specify any contents for the SOAP body, allowing the development of identity services within
113 the context of the Liberty Identity Web Services Framework. The layering is schematically depicted in [Figure 2](#).



114

115

Figure 2. Liberty ID-WSF Protocol Architecture

116 1.5. Synopsis of Specifications

117 1.5.1. ID-WSF SOAP Binding (ID-WSF/Normative)

118 The ID-WSF SOAP Binding ([\[LibertySOAPBinding\]](#)) provides a SOAP-based invocation framework for identity
119 services. It defines SOAP Header blocks and processing rules enabling the invocation of identity services via SOAP
120 requests and responses. Additionally, a usage directive container is defined for those implementations that wish to use
121 an existing rights expression language to specify the required service and data usage policies.

122 1.5.2. ID-WSF Security Mechanisms (ID-WSF/Normative)

123 The ID-WSF Security Mechanisms ([\[LibertySecMech\]](#)) describes profiles and requirements for securing the discovery
124 and use of identity services. It includes security requirements to both protect privacy, and to ensure integrity and
125 confidentiality of messages between Service Providers.

126 1.5.3. ID-WSF Discovery Service (ID-WSF/Normative)

127 The ID-WSF Discovery Service ([\[LibertyDisco\]](#)) defines a core identity service that enables various entities (e.g.
128 Service Providers) to dynamically discover a Principal's registered identity services. Given the type of service
129 desired (e.g. Personal Profile service ([\[LibertyIDPP\]](#))), the Discovery Service responds with a service description
130 containing WSDL ([\[WSDLv1.1\]](#)) for the desired identity service, provided that permissions set by the Principal allow
131 the disclosure of these resources to the relevant entity. The Discovery Service can also function as a security token
132 service, issuing security tokens to the requester that the requester will use in the request to the discovered identity
133 service.

134 1.5.4. ID-WSF Data Services Template (ID-WSF/Normative)

135 The ID-WSF Data Services Template ([\[LibertyDST\]](#)) provides the building blocks when implementing a data service
136 (e.g. Personal Profile service ([\[LibertyIDPP\]](#))) on top of the Identity Web Services Framework. The specification
137 defines how to query and modify data stored in a data service and provides some common attributes for data services.

138 1.5.5. ID-WSF Interaction Service (ID-WSF/Normative)

139 An identity service may need to obtain permission from a user (or someone who owns a resource on behalf of that
140 user) to allow them to share data with requesting services. The ID-WSF Interaction Service ([\[LibertyInteract\]](#)) details
141 protocols and profiles for interactions that allow services to carry out such actions.

142 **1.5.6. ID-WSF Profiles for Liberty-enabled User Agents or Devices (ID-WSF/Normative)**

144 ID-WSF Profiles for Liberty-enabled User Agents or Devices ([\[LibertyClientProfiles\]](#)) describes the profiles and
145 requirements for Liberty-enabled clients interacting with the SOAP based authentication service. A user agent or
146 device that has specific support for one or more profiles of the Liberty specifications. It should be noted that although
147 a standard web browser can be used in many Liberty-specified scenarios, it does not provide specific support for the
148 Liberty protocols, and thus is not a Liberty-enabled User Agent or Device (LUAD). No particular claims of specific
149 functionality should be implied about a system entity solely based on its definition as a LUAD. Rather, a LUAD
150 may perform one or more Liberty system entity roles as defined by the Liberty specifications it implements. For
151 example, a LUAD-WSC is not a website that acts as a Service Provider, but a user agent or device that wants to make
152 access to identity service, and a LUAD-DS is a user agent or device offering a Liberty ID-WSF Discovery Service
153 ([\[LibertyDisco\]](#)).

154 **1.5.7. Metadata (ID-FF/ID-WSF Independent)**

155 The Metadata ([\[LibertyMetadata\]](#)) defines schema and protocols that facilitate real-time requests for metadata
156 (previously assumed to be an out-of-band transfer). This will allow more spontaneous conversations between Liberty-
157 compliant entities. A mechanism is defined for publishing the metadata. Several mechanisms for retrieving the
158 metadata are defined (DNS ([\[RFC1034\]](#)), well known location). The metadata architecture is designed to be flexible
159 going forward.

160 Functionally, there are three primary functions for this metadata:

- 161 • **entity core metadata**, which covers the metadata elements introduced in release 1 of the protocol with additional
162 elements introduced in this release. Core metadata includes information about cryptographic keys used by entities,
163 SOAP related information for service endpoints, as well as Identity/Service Provider specific information and other
164 service related information.
- 165 • **entity trust metadata**, which enables entities to cast business decisions based on the characteristic trust informa-
166 tion provided in this class. This is not defined within the Alliance, but the metadata architecture could be used to
167 publish or retrieve this data.
- 168 • **origin and document verification** through signature use in (server authenticated) HTTPS retrieval of the instance
169 documents, DNS signatures ([\[RFC1034\]](#)), and document level signatures

170 **1.5.8. Reverse HTTP Binding (ID-FF/ID-WSF Independent)**

171 The Reverse HTTP Binding ([\[LibertyPAOS\]](#)) enables a normal HTTP-based user-agent to receive SOAP requests
172 inside an HTTP response. This allows end users to host identity services on their devices without running an HTTP
173 server or being IP addressable from the Internet.

174 **1.5.9. SOAP Authentication Service (ID-FF/ID-WSF Independent)**

175 In the ID-WSF context, entities (e.g. Web Service Consumer and Web Service Provider) may need to be authenticated
176 by exchanging SOAP messages each other. However, SOAP specifications ([\[SOAPv1.1\]](#)[\[SOAPv1.2\]](#)) do not specify
177 any particular security mechanisms. The SOAP Authentication Service ([\[LibertyAuthn\]](#)) defines authentication
178 protocol between entities over SOAP, based on a profile of Simple Authentication and Security Layer framework
179 ([\[RFC2222\]](#)). It also defines ID-WSF Authentication Service that an Identity Provider may offer in the ID-WSF

180 context, and ID-WSF Single Sign-On Service. The former enables Web Service Consumer and/or LUAD to be
181 authenticated by Identity Providers and obtain ID-WSF security tokens. The latter enables Web Service Consumer
182 to obtain assertions within the ID-WSF context, that can be used in the ID-FF context.

183 **2. ID-WSF User Experience Example**

184 This section provides a simple, plausible examples of the Liberty ID-WSF user experience, from the perspective of the
185 user, to set the overall context for additional technical details. As such, actual technical details are hidden or simplified.

186 Note: The user experience examples presented in this section are non-normative and are presented for illustrative
187 purposes only.

188 **2.1. Usage Examples with three websites**

189 In this section, a simple ID-WSF user experience example is described, in which Joe Self is ordering beer and pizza
190 on the Internet. More details of this example from the implementer point of view are described in the Liberty ID-WSF
191 Implementation Guide ([\[LibertyIDWSFGuide\]](#)).

192 **2.1.1. Assumptions**

193 These user experience examples are based upon the following set of actors:

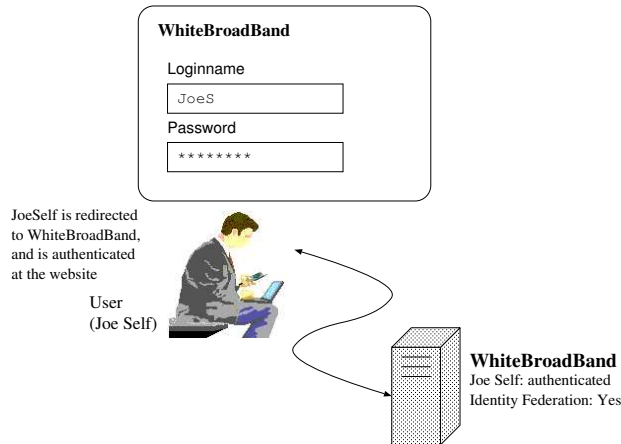
- 194 • Joe Self: A user of Web-based online services.
- 195 • WhiteBroadBand: Internet service provider that acts as his Identity Provider. It also hosts a Discovery Service
196 ([\[LibertyDisco\]](#)).
- 197 • BlueLiquor: A liquor shop website.
- 198 • YellowPizza: A pizzeria website.

199 This user experience example assumes two things:

- 200 • Identity federation has occurred for Joe Self's accounts at WhiteBroadBand and BlueLiquor. Joe Self registers his
201 personal information at BlueLiquor website for delivering ordered liquors to customer's residence. BlueLiquor is
202 also able to provide other websites with a customer's personal information if the customer has provided permission.
- 203 • Identity federation has occurred for Joe Self's accounts at WhiteBroadBand and YellowPizza. YellowPizza can
204 discover customer's identity services by interacting with WhiteBroadBand so that it gets customer's shipping
205 address information and delivers pizza there.

206 **2.1.2. User Experience Scenario**

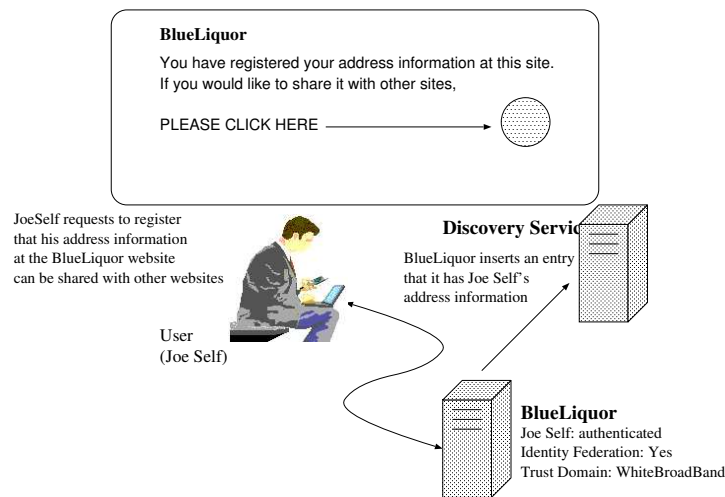
207 One day on Sunday, Joe decides to order beers at BlueLiquor website that is his favorite liquor shop. When he tried to
208 make access to BlueLiquor website, he is redirected to WhiteBroadBand website since he has not been authenticated.
209 WhiteBroadBand is his Identity Provider, and he submits his credential to WhiteBroadBand. Once he is authenticated
210 by WhiteBroadBand, he can make access to the BlueLiquor website.



211

212 **Figure 3. Joe Self is redirected to WhiteBroadBand website that is his Identity Provider**

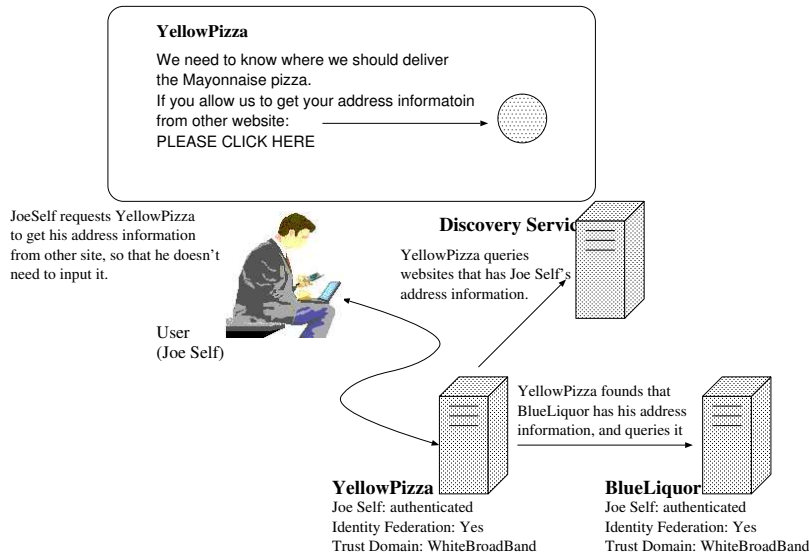
213 He orders two dozen beers at the BlueLiquor website, and ask to deliver them to his pre-registered shipping
214 address. He also requests BlueLiquor to register that his shipping address information is available at this site, to
215 the Discovery Service ([LibertyDisco](#)) hosted by WhiteBroadBand, so that his shipping address information attribute
216 at the BlueLiquor website can be shared with other websites. BlueLiquor registers it to Discovery Service, and sets
217 Joe's attribute sharing policy as it can be shared with other websites.



218

219 **Figure 4. Joe Self requests BlueLiquor website to register that his address information can be shared**

220 Subsequently, he tries to make access to the YellowPizza website. Since he has already been authenticated by
221 WhiteBroadBand, he does not need to be authenticated again. He orders a mayonnaise pizza, and is asked where
222 they should deliver it. He requests YellowPizza to get his shipping address information from other website, and they
223 get it from the BlueLiquor website. Finally, two dozen beers and the mayonnaise pizza are delivered to his residence.



224

225

Figure 5. Joe Self requests YellowPizza website to get his address information from other website

226 2.2. Usage Examples with Mobile IdP

227 2.2.1. Assumptions

228 These user experience examples are based upon the following set of actors:

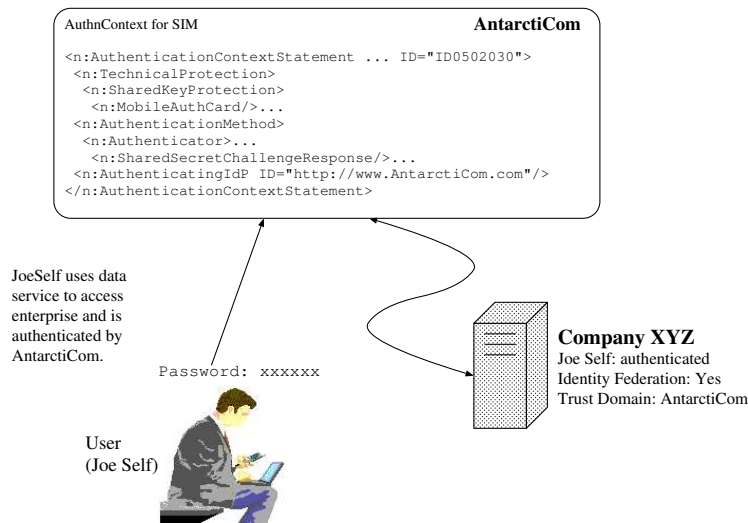
- 229 • Joe Self: A user of Web-based online services.
- 230 • Company XYZ: Joe self's employer. Joe Self is a Vice President for XYZ in charge of buying widgets. When Joe
231 is in the office, Company XYZ acts as his Identity Provider.
- 232 • Company ABC: A Vendor of widgets that works closely with Company XYZ.
- 233 • Mobile IdP AntarctiCom: A Mobile Operator who acts as Identity Provider for Joe Self when not in the office.
- 234 • Airline, Inc.: One of the airline company that is able to get customer's personal information from other websites.

235 The Liberty ID-WSF user experience assumes three things:

- 236 • Identity federation has occurred for Joe Self's accounts at Company XYZ and Company ABC. At Company ABC
237 there are access policies that recognize Joe Self as an Employee of Company XYZ who is authorized to purchase
238 widgets.
- 239 • Identity federation has occurred for Joe Self's accounts between Company XYZ and AntarctiCom. Business
240 agreements have been signed between Company XYZ and AntarctiCom such that AntarctiCom may authenticate
241 Company XYZ's users, and that Company XYZ may chain these assertions when interacting with their own
242 partners.
- 243 • Identity federation has occurred for Joe Self's accounts between Airline, Inc. and AntarctiCom. Business agree-
244 ments have been signed between Airline, Inc. and AntarctiCom such that AntarctiCom may authenticate Airline's
245 customers, and that Airline, Inc. can discover customer's identity services by interacting with AntarctiCom.

246 **2.2.2. User Experience Scenario**

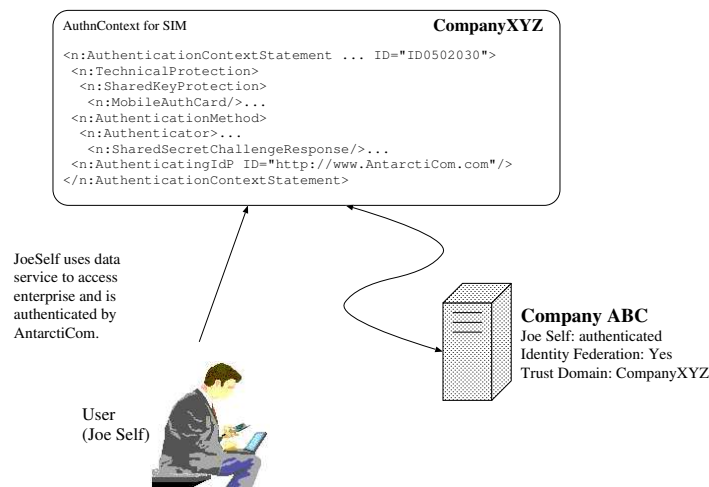
247 Joe Self is on the road at a big conference. He is presenting on widgets and their importance to Company XYZ's
 248 businesses. After his big presentation, he decides to access his corporate web portal with his browser in order to
 249 check his e-mail. He turns on his Mobile Data device, say a GSM phone with GPRS capability, and the Mobile IdP,
 250 AntarctiCom, authenticates his device.



251

252 **Figure 6. Joe Self Authenticated by AntarctiCom, Navigates to XYZ Portal**

253 Joe Self finds out that XYZ has won a big order. They will need to buy widgets to make their products. Joe Self
 254 navigates to Company ABC's portal to check widget prices. Company ABC is a prime supplier to Company XYZ, so
 255 if the prices are fair Joe Self will buy from them. CompanyABC and CompanyXYZ have set up contracts and installed
 256 infrastructure in order to allow federation of accounts between their trust domains. Unfortunately Company ABC does
 257 not recognize AntarctiCom as an Identity Provider. XYZ and AntarctiCom have business agreements such that they
 258 can chain authentication though.

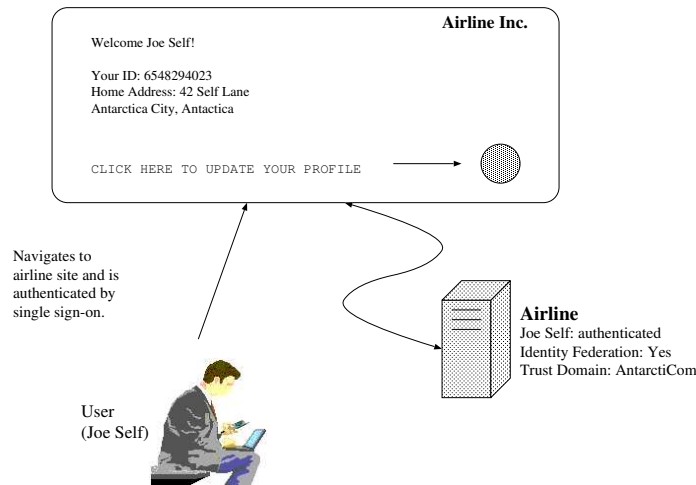


259

260 **Figure 7. Joe Self Navigates to Company ABC, uses XYZ as Identity Provider**

261 Joe checks the prices of widgets. They look good. He would like to buy. ABC has access control policies that
 262 require the use of a one time password in addition to the Identity Providers SIM based Authentication for that level
 263 of transaction. Joe provides the password and the order is processed. Joe decides that he better just change his flight
 264 home so that he can be in the office to discuss the order with his staff. Unfortunately the flight is full. Joe navigates

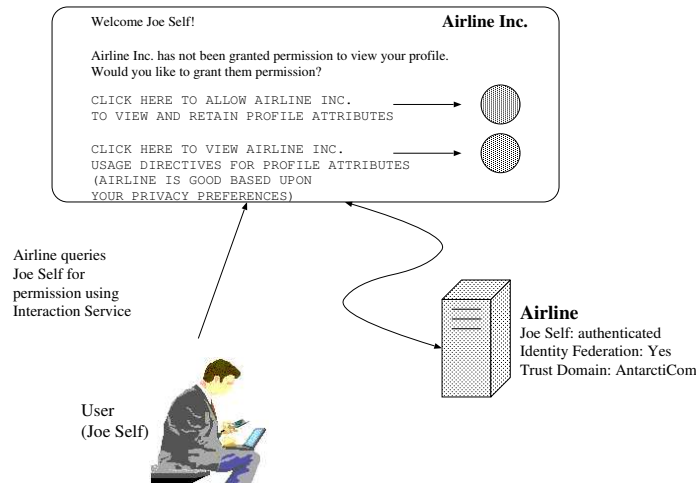
265 to another airline but notices that his personal information is not up to date. The airline was able to discover Joe's
266 Personal Profile ([LibertyIDPP]) during his sign-on at the site. He clicks on a button on the web page to update his
267 profile at the airline.



268

269 **Figure 8. Joe Self Navigates to Airline site, uses AntarctiCom as Identity Provider**

270 Joe Self has set his permissions at AntarctiCom such that he wants to be asked for permission prior to Personal Profile
271 ([LibertyIDPP]) attributes being released to Service Providers. AntarctiCom uses the Liberty ID-WSF Interaction
272 Service ([LibertyInteract]) to query Joe Self for permission to release certain Personal Profile attributes.

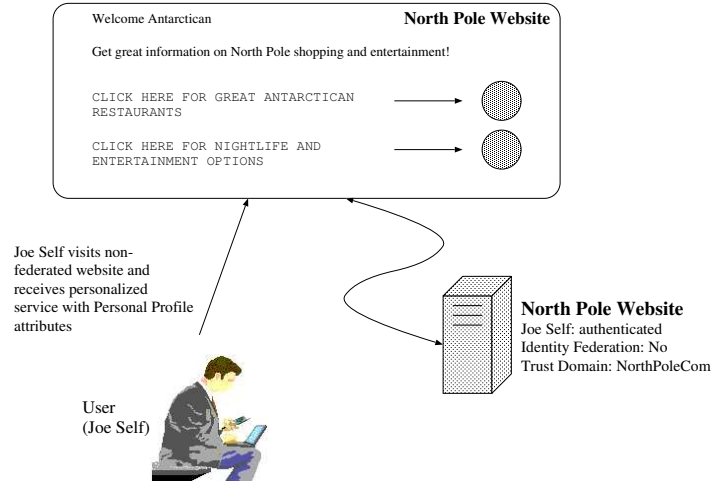


273

274 **Figure 9. Airline uses Interaction Service to get permission to invoke Joe Self's Personal Profile**

275 Joe Self is leaving Antarctica next week, and he is not sure that AntarctiCom will have data services in the visited
276 network¹. He decides to set up his own Personal Profile service on the mobile device that he is using. Upon arriving
277 in the North Pole, he sets permissions on his Personal Profile service such that his Postal Code and Nationality will be
278 available to visited Service Providers. Joe Self then receives personalized service when visiting websites. In addition,
279 should Service Providers require additional information, they can directly query Joe Self. The ability to query is
280 provided by the Liberty ID-WSF Interaction Service ([LibertyInteract]) defined as part of the Liberty specifications.

¹A visited network is the network other than the home network of a mobile device, to which the mobile device is currently connected. It is usually referred as such from the mobile operator point of view.



281

282 **Figure 10. Joe Self visits North Pole website, privacy neutral Personal Profile attributes provided based upon set**
283 **preferences for new Service Providers**

284 The mobile device examples shows a scenario with the optimizations from the use of Reverse HTTP Binding
285 ([\[LibertyPAOS\]](#)), the use of LUAD for discovery of Web Services on the mobile device ([\[LibertyClientProfiles\]](#)),
286 as well as use of the SOAP Authentication Service for authentication of the LECP ([\[LibertyAuthn\]](#)).

287 **3. Liberty Engineering Requirements Summary**

288 This section summarizes the Liberty general and functional engineering requirements.

289 **3.1. General Requirements**

290 The Liberty-enabled systems should follow the set of general principals outlined in [Section 3.1.1](#) and [Section 3.1.2](#).
291 These principles cut across categories of functionality.

292 **3.1.1. Client Device/User Agent Interoperability**

293 Liberty clients encompass a broad range of presently deployed Web browsers, other presently deployed Web-enabled
294 client access devices, and newly designed Web-enabled browsers or clients with specific Liberty-enabled features.

295 The Liberty architecture and protocol specifications must support a basic level of functionality across the range of
296 Liberty clients.

297 **3.1.2. Openness Requirements**

298 Liberty architecture and protocol specifications must provide the widest possible support for

- 299 • Operating systems
- 300 • Programming languages
- 301 • Network infrastructures

302 and must not impede multivendor interoperability between Liberty clients and services, including interoperability
303 across circle of trust boundaries.

304 **3.2. Functional Requirements**

305 Liberty architecture and protocols must be specified so that Liberty-enabled implementations are capable of perform-
306 ing the following activities:

- 307 • Service discovery in identity federation environment
- 308 • Registration of services
- 309 • Support for gathering consent from a Principal
- 310 • Support for anonymous services
- 311 • Support for usage directives

312 **3.2.1. Service Discovery**

313 Requirements of service discovery stipulate that

- 314 • Architecture provides a mechanism for Service Providers to query the Discovery Service for the relevant providers
315 of services or attribute classes within a service for a particular Principal.

- 316 • Support for user prompt by the Discovery Server to prompt during the registration process (e.g. to confirm the
317 registration). Such mechanism(s) should support the ability to allow the requestor to prompt the user, asking the
318 requestor to direct the user to the Discovery Server's site, or the Discovery Server using a LECP communications
319 channel to ask the user directly.

320 **3.2.2. Registration of Services**

321 Requirements of service registration stipulate that

- 322 • Architecture provides a mechanism for Service Providers to register/deregister with the Discovery Service a list of
323 services or attribute classes within a service that it provides for a specific Principal.

324 **3.2.3. Support for Gathering Consent**

325 Requirements of consent gathering stipulate that

- 326 • Mechanism for a relying Service Provider to request that the invoking Service Provider direct a Principal to the
327 relying Service Provider to request the Principal for consent.
- 328 • Mechanism for a Service Provider to utilize a LECP communications channel for querying the Principal's consent
329 and obtaining the Principal's response.
- 330 • Mechanism for Providers to associate Principal's consent for his/her permissions for a Service Provider for a given
331 set of attributes, when the set of attributes are shared with the Service Provider.
- 332 • Mechanism for a relying Service Provider to partially fulfill requests for attributes if consent not given for all
333 attributes.

334 **3.2.4. Support for Anonymous Service**

335 Requirements of anonymous service stipulate that

- 336 • Mechanism for a Service Provider to make anonymous attribute requests and receive anonymous attribute
337 responses. (Ability to share attributes without disclosing the identity of the Principal to the requestor or Service
338 Provider).
- 339 • Mechanism to prevent correlation of pseudonyms in service tokens with Principal Identifiers.

340 **3.2.5. Support for Usage Directives**

341 Requirements of usage directives stipulate that

- 342 • Mechanism for a Service Provider to associate intended usage with the requested attributes in an attribute request
343 to a relying Service Provider.
- 344 • Mechanism for a Service Provider to associate the agreed upon intended usage directives with the attribute response

- 345 • Mechanism for a Service Provider to return a list of acceptable usage directives to a Service Provider, when the
346 intended usage doesn't match the Principal's usage directives.

- 347 • Guideline for Service Providers (in the usage negotiation scenario) to always reply to an invoking Service
348 Provider's attribute request with usage directives that are equal to or privacy-stricter than those originally stated in
349 the Service Provider's attribute request.

350 4. Liberty Security Architecture

351 [Table 1](#) generally summarizes the security mechanisms incorporated in the Liberty specifications, and thus in Liberty-
352 enabled implementations, across two axes: channel security and message security. It also generally summarizes the
353 security-oriented processing requirements placed on Liberty implementations.

354 Note: This section is non-normative, please refer to normative documents for detailed normative statements regarding
355 security mechanisms ([\[LibertySecMech\]](#)).

356 **Table 1. Liberty Security Mechanisms**

Security Mechanism	Channel Security	Message Security (for Requests, Assertions)
Confidentiality	Required	Optional
Per-message data integrity		Required
Transaction integrity		Required
Data origin authentication		Required
Nonrepudiation		Required

357 Channel security addresses how communication between Identity Providers, Service Providers, and user agents is
358 protected. Liberty implementations must use TLS1.0 ([\[RFC2246\]](#)) or SSL3.0 ([\[SSL\]](#)) for channel security, although
359 other communication security protocols may also be employed, for example, IPsec, if their security characteristics are
360 equivalent to TLS1.0 or SSL3.0. Note: TLS1.0, SSL3.0, and equivalent protocols provide confidentiality and integrity
361 protection to communications between parties as well as authentication.

362 Critical points of channel security include the following:

- 363 • In terms of authentication, Service Providers are required to authenticate Identity Providers using Identity Provider
364 server-side certificates. Identity Providers have the option to require authentication of Service Providers using
365 Service Provider client-side certificates.
- 366 • Additionally, each Service Provider is required to configure a list of authorized Identity Providers, and each Identity
367 Provider is required to be configured with a list of authorized Service Providers. Thus any Service Provider-Identity
368 Provider pair must be mutually authorized before they will engage in Liberty interactions. Such authorization is
369 in addition to authentication. (Note: The format of this configuration is a local matter and could, for example, be
370 represented as lists of names or as sets of X.509 certificates ([\[X.509\]](#)) of other circle of trust members).
- 371 • The authenticated identity of an Identity Provider must be presented to a user before the user presents personal
372 authentication data to that Identity Provider.

373 Message security addresses security mechanisms applied to the discrete Liberty protocol messages passed between
374 Identity Providers, Service Providers, and user agents. These messages are exchanged across the communication
375 channels whose security characteristics were just discussed.

376 Critical points of message security include the following:

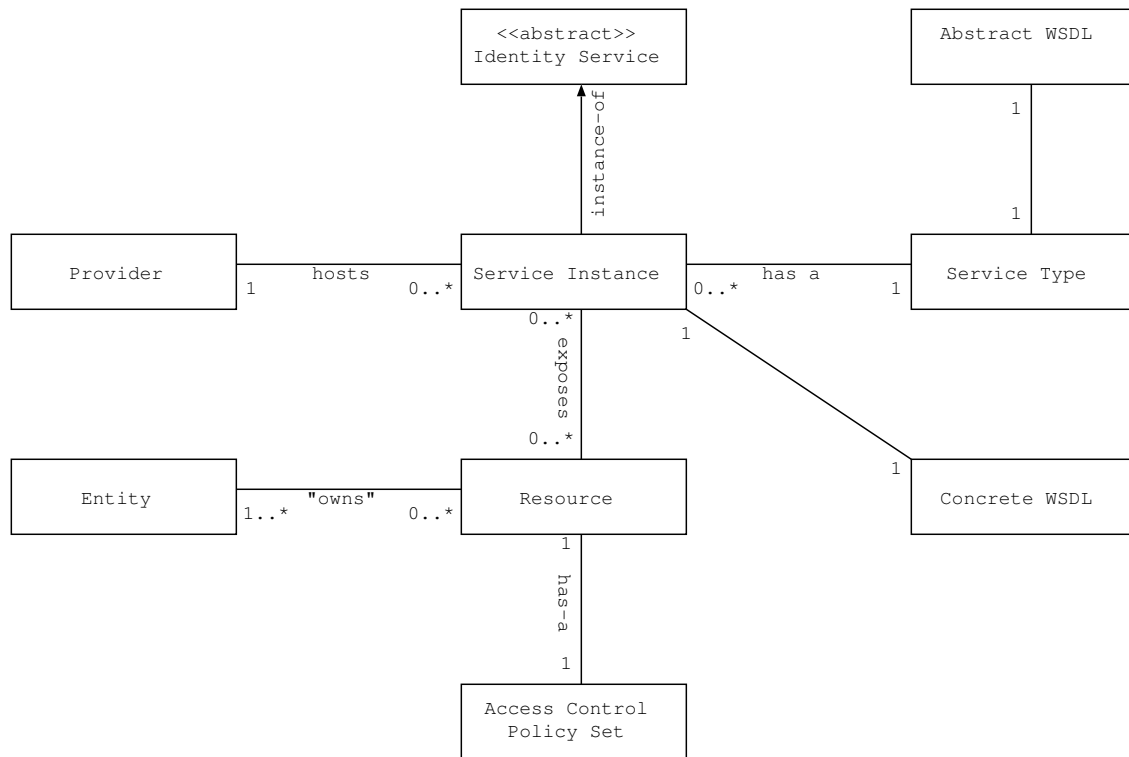
- 377 • Liberty protocol messages and some of their components are generally required to be digitally signed and verified.
378 Signing and verifying messages provide data integrity, data origin authentication, and a basis for non-repudiation.
- 379 • Therefore, Identity Providers and Service Providers are required to use key pairs that are distinct from the key
380 pairs applied for TLS1.0 ([\[RFC2246\]](#)) or SSL3.0 ([\[SSL\]](#)) channel protection and that are suitable for long-term
381 signatures.

- 382 • In transactions between Service Providers and Identity Providers, requests are required to be protected against
383 replay, and received responses are required to be checked for correct correspondence with issued requests. Time-
384 based assurance of freshness may be employed. These techniques provide transaction integrity.
- 385 • To become circle of trust members, providers are required to establish bilateral agreements on selecting certificate
386 authorities, obtaining X.509 credentials ([\[X.509\]](#)), establishing and managing trusted public keys, and managing
387 life cycles of corresponding credentials.
- 388 Note: Many of the security mechanisms mentioned above, for example, TLS1.0 or SSL3.0, have dependencies upon,
389 or interact with, other network services and/or facilities such as the DNS ([\[RFC1034\]](#)), time services, firewalls, etc.
390 These latter services and/or facilities have their own security considerations upon which Liberty-enabled systems are
391 thus dependent.

392 5. Liberty Architecture

393 5.1. Concepts and Architecture

394 The Liberty ID-WSF defines a framework for creating, discovering, and consuming *identity services*. The Liberty ID-
 395 WSF also defines a conceptual model that provides relevant terminology for these *identity services*. Some basic
 396 identity services, such as the Discovery Service ([LibertyDisco]), are defined in a normative manner as part of
 397 the ID-WSF specifications. The following UML model describes the conceptual model presented in the Liberty
 398 specifications:



399

400

Figure 11. UML Representation of Liberty Conceptual Model

401 An *identity service* is an abstract notion of a web service that acts upon some resource to either retrieve information
 402 about an identity or identities, update information about an identity or identities, or perform some action for the benefit
 403 of some identity or identities.

404 There are different types of identity services, each of which is identified by a *service type identifier*. This service type
 405 identifier maps to exactly one *abstract WSDL* definition of a service. The definition contains only the type, message,
 406 and portType elements of a WSDL1.1 description ([WSDLv1.1]). An example of a service type is a "calendar service,"
 407 which could have a service type identifier of a URI such as "urn:example:services:calendar".

408 A *service instance* is the instantiation of a particular type of identity service. A service instance maps to a *concrete*
 409 *WSDL* document (which includes the binding and service WSDL elements) that contains the *protocol endpoint* and
 410 additional information necessary for a client to communicate with the particular service instance (e.g. security policy
 411 information).

412 Each service instance is hosted by some *provider* that is identified by a *provider identifier*. An example of a service
 413 instance is a SOAP endpoint ([SOAPv1.1][SOAPv1.2]) offering a calendar service.

414 A service instance exposes a protocol interface to a set of resources. A *resource* in this specification is either data
415 related to some identity or identities, or a service acting on behalf of some identity or group of identities. An example
416 of a resource is a calendar containing appointments for a particular identity.

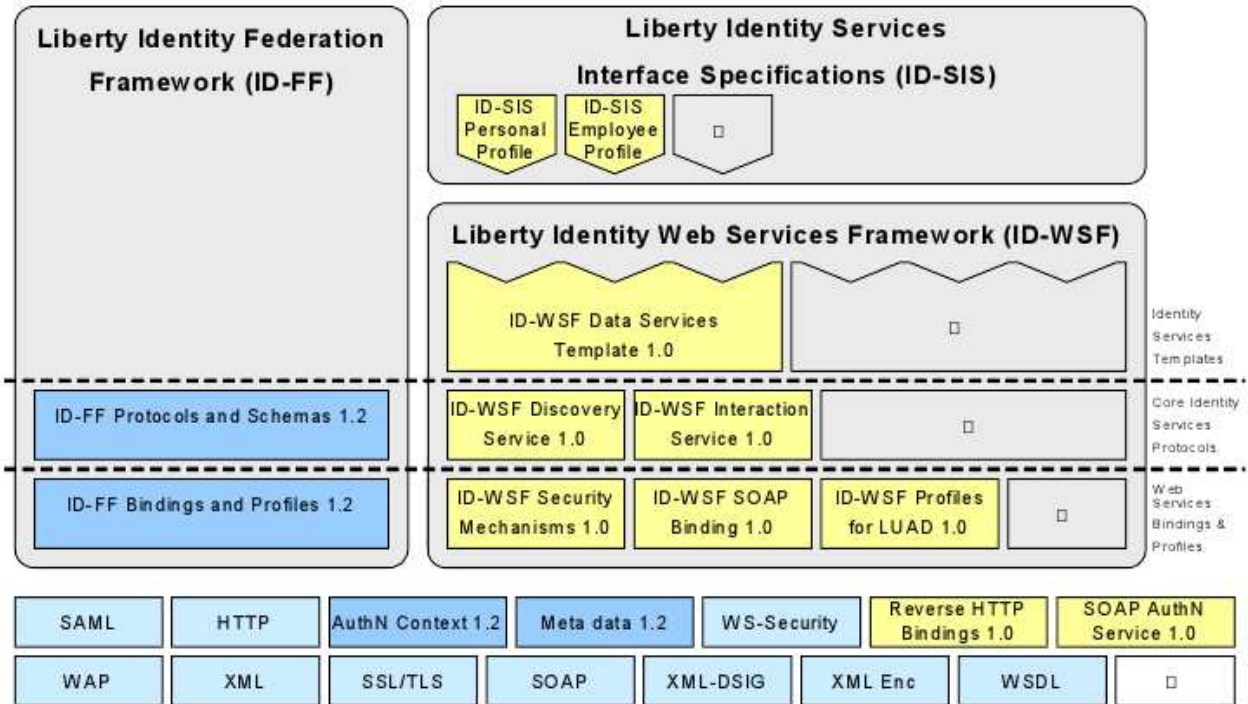
417 A resource commonly has *access control policies* associated with it. These access control policies are typically under
418 the purview of the entity or entities associated with the resource (the entity or entities could be considered to "own"
419 the resource). The access control policies on a resource must be enforced by the service instance.

420 **5.2. Liberty Modules**

421 The Liberty architecture consists of a multi-level layered specification set, based on open standards including SAML
422 ([\[SAMLCore11\]](#)) and SOAP ([\[SOAPv1.1\]](#)[\[SOAPv1.2\]](#)). There are three major components of the Liberty architecture:

- 423 • The Liberty Identity Federation Framework (ID-FF) specifies core protocols, schemata and concrete profiles that
424 allow implementers to create a standardized, multi-vendor, identity federation network.
- 425 • The Liberty Identity Web Services Framework (ID-WSF) consists of a set of schemata, protocols and profiles for
426 providing a basic framework of identity services, such as identity service discovery and invocation.
- 427 • Liberty Identity Service Interface Specifications (ID-SIS) utilize the ID-WSF and ID-FF to provide networked
428 identity services, such as contacts, presence detection or wallet services that depend on networked identity.

429 [Figure 12](#) below illustrates the Liberty Modules and their corresponding functional areas.



430

431

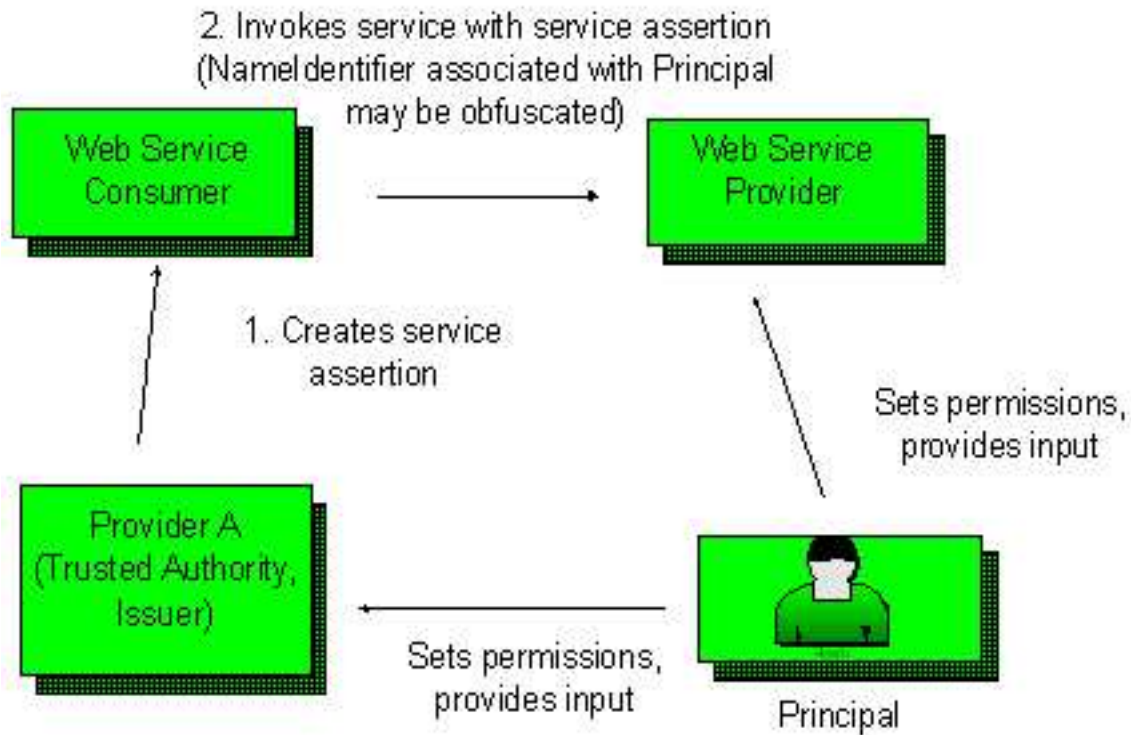
Figure 12. Liberty Modules

432 5.3. Summary of Functionalities

433 The Liberty Identity Web Services Framework defines a SOAP based invocation framework that allows identity
 434 services to be discovered and invoked. Once a service has been discovered and sufficient authorization data has
 435 been received from a trusted authority, the invoking entity (Web Service Consumer) may invoke the service at
 436 the hosting/relying entity (Web Service Provider). In order to convey the privilege of a system entity to access a
 437 resource, the framework defines extensions such that service invocation authorization data may be generated by a
 438 trusted authority and issued to the invoking system entity. The relying party or Web Service Provider can make
 439 access control decisions based upon this authorization data based upon its business practices and the preferences of
 440 the resource owner. In most cases this trusted authority is assumed to be some Identity Provider/Discovery Service
 441 ([LibertyDisco](#)).

442 The following diagram illustrates the entities involved in possible service invocation use cases.

Service Invocation



443

444

Figure 13. Service Invocation Context

445 5.3.1. Security Mechanisms

446 As in other web services contexts, access control policies must be enforced in an identity services context. The
447 authorization decision to invoke an identity service instance offering a specific resource may be made locally (that
448 is at the entity hosting the resource) or remotely. Regardless of whether the policy decision is distributed or not,
449 in a permissions based context or any context with security considerations, a policy enforcement must always be
450 implemented by the entity hosting the resource.

451 Identity services may rely upon a trusted third party (TTP) to make policy decisions on their behalf. In such cases, the
452 TTP issues targeted SAML assertions ([SAMLCore11]) to those entities. These assertions have associated conditions,
453 such as an issue instant, validity periods for each assertion. The SAML assertion also has audience restriction(s) that
454 provide information about the intended target of the policy decision and the relying party (Web Service Provider)
455 for the particular assertion. The SAML assertion also contains an Authorization Decision Statement which conveys
456 the decision and information about the rights that have been granted to the resource. The Authorization Decision
457 Statement also conveys information about the Subject and the Subject Confirmation Method by which the requesting
458 entity will authenticate itself to the relying party.

459 5.3.2. Usage Directives

460 The Liberty ID-WSF defines extensions that allow both the invoking entity and the consuming entity to add one or
461 more Usage Directive SOAP headers to a message ([LibertySOAPBinding]). A Usage Directive header in a request

462 from the invoking entity can be understood as "intended usage". It should be noted that should permissions be such
463 that a Usage Directives level in the request cannot be met, the hosting entity must either redirect the invoking entity to
464 the user to query for permission, or deny the service.

465 **5.3.3. Interaction Service**

466 The Liberty ID-WSF defines a Interaction Service protocol ([\[LibertyInteract\]](#)). This protocol provides schemas and
467 profiles to enable an entity to interact with the owner of a resource that is exposed by that Web Service Provider. The
468 ID-WSF defines three methods for a Web Service Provider to interact with a user:

- 469 1. The Web Service Provider may send a SOAP response with a RedirectRequest that instructs the Web Service
470 Consumer to direct the user-agent to contact the Web Service Provider at a given URL.
- 471 2. The Web Service Provider may send a UserInteractionRequest to the endpoint defined in the ISService element.
- 472 3. The Web Service Provider may try to discover the Interaction Service of the resource owner to enable the Web
473 Service Provider to send a userInteractionRequest to that service.

474 This interaction may be for the purposes of obtaining consent for a particular resource exposure (such as granting
475 access to Personal Profile ([\[LibertyIDPP\]](#))), obtaining data from the user-agent, or some other purpose. The Interaction
476 Service protocol is an optional part of the Liberty ID-WSF. An example of use of the Interaction Service would be to
477 query the user for permissions in a web services context.

478 **5.3.4. Proxy Authorization Model**

479 The Liberty ID-WSF supports a restricted form of proxy authorization capability whereby a consumer of an identity
480 service (the intermediate system entity or proxy) can act on behalf of another system entity (the subject) to access an
481 identity service (the recipient) ([\[LibertySecMech\]](#)). To be granted the right to proxy for a subject, the intermediate
482 system entity may need to interact with a trusted authority. Based on the authority's access control policies, the
483 authority may generate and distribute an assertion authorizing the intermediary to act on behalf of the subject to the
484 recipient. As an example, such the authorization decision statement might allow a proxying entity to update a calendar
485 resource for a particular identity after a flight booking has occurred.

486 **5.3.5. Affiliations**

487 An affiliation allows a group of Service Providers organized to act as a single entity from the point of view of the
488 customer (usually due to the group acting as a portal or acting as a single company such as TimeWarner and its
489 affiliates). The Liberty Authorization Decision Statement defined allows the use of the Affiliation ID when a trusted
490 authority is granting rights to a member of an affiliation group ([\[LibertyProtSchema\]](#)). An example of the use of
491 affiliations in an application context is an Authorization Decision Statement allowing Travel Affiliation X to update a
492 calendar after a flight booking has occurred.

493 **5.3.6. Chaining of Services/Broker**

494 The ID-WSF architecture provides mechanisms to allow a broker type functionality, whereby a Web Service Consumer
495 may make a request to a Web Service Provider which acts as a broker and makes subsequent requests (as a Web Service
496 Consumer) to other Web Service Provider(s) that have the required information. The broker subsequently aggregates
497 the data and responds to the originating Web Service Consumer in the chain. A simple example is profile data that is
498 stored in various places and the broker needs to query the relevant parties for the data prior to responding to a Personal
499 Profile request.

500 **5.3.7. Anonymous Service Requests**

501 The trusted third party may obscure the subject's name identifier for purposes of confidentiality at the Web Service
502 Consumer and any subsequent intermediaries. For this purpose, the ID-WSF specifies a mechanism for creating (at
503 issuer) and consuming (at relying party) encrypted name identifiers.

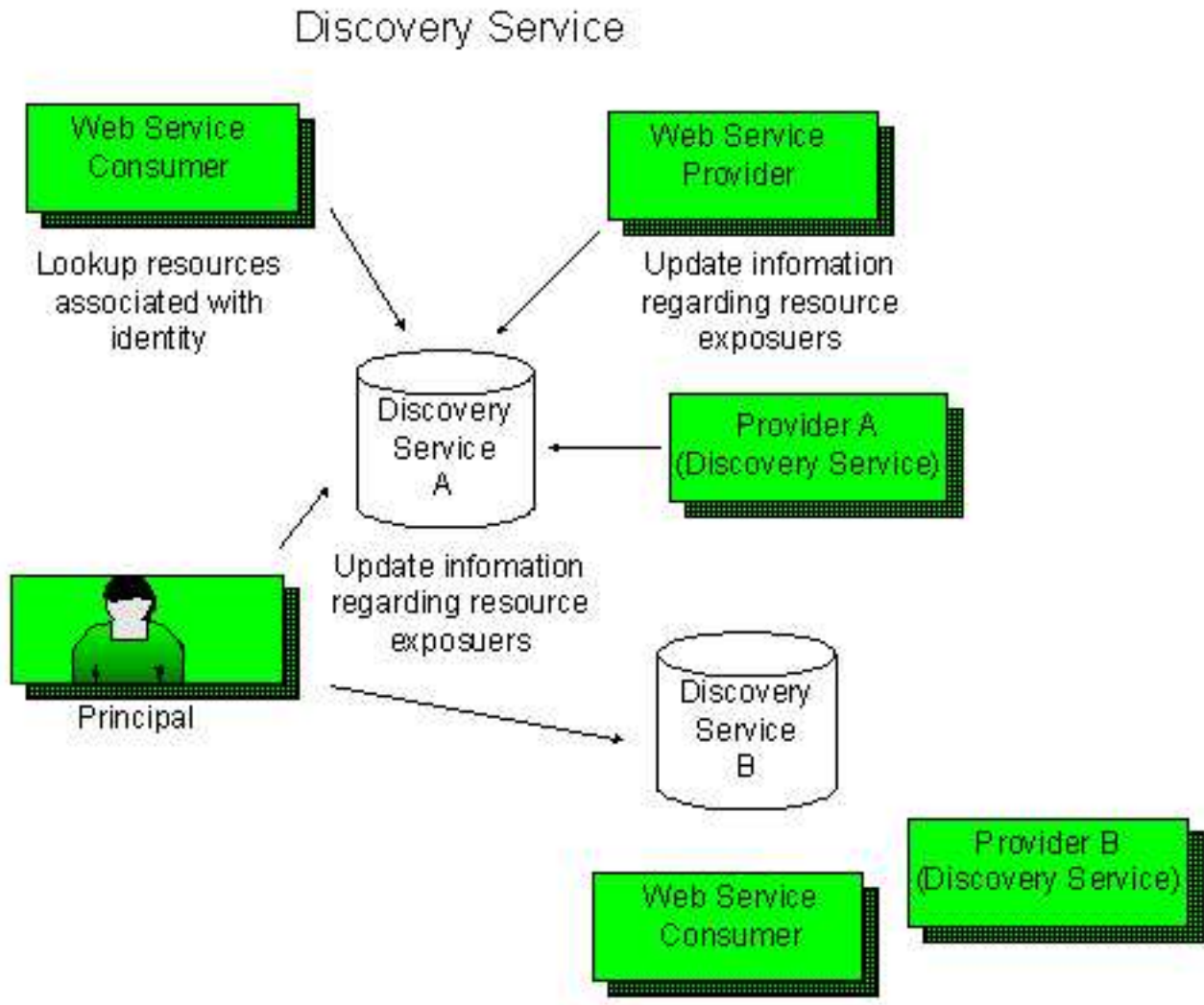
504 **5.3.8. Discovery Service**

505 The Discovery Service is a type of identity service that provides for the discovery of resource exposures associated
506 with a given identity ([LibertyDisco](#)). An identity will typically have one or more discovery services on the network
507 that allow other entities to discover its identity services.

508 The Discovery Service offers two operations, Lookup and Update. In a web services context (browsing, etc.), a Web
509 Services Consumer may need access to a resource exposure associated with an identity (a profile or location service).
510 The Web Service Consumer may lookup a service instance with a request that includes a service type element and
511 extensible processing directives. The response message contains the relevant resources associated with the query,
512 according to the access policies set by the principal/provider. The response may include tokens for service invocation.

513 The Update operation allows a requester to enter and remove service instances. The request allows the provider to
514 input information about a resource exposure, and the corresponding response provides the status of the request. A
515 Web Service Provider that hosts the resource, the host of the Directory Service, or the Principal/Resource Owner
516 could update the resource exposure. The service registry defined by the Liberty ID-WSF has one service entry for
517 each service type, consequently complex queries are not possible. This does not preclude having some ability to
518 change the Lookup results based upon the access control policies of the host, and/or preferences/permissions of the
519 resource owner. The following diagram illustrates the entities involved in possible Discovery Service use cases.

520



521

522

Figure 14. Liberty Discovery Service

523 5.4. Use Cases in scope for ID-WSF

524 The Liberty Alliance defines a Personal Profile service ([LibertyIDPP]) for use with the Liberty ID-WSF. The Personal
525 Profile service is designed to facilitate account creation in a web services context. The Personal Profile service allows a
526 Web Service Consumer to gather the information necessary to create an account or provide personalized services. The
527 Personal Profile specification provides a schema and API for queries of personal information. The ID-WSF provides
528 Personal Profile deployments and other ID-SIS deployments with the abilities to specify and negotiate usage directives
529 for attribute sharing, to query users for permissions using the Liberty ID-WSF Interaction Service ([LibertyInteract]),
530 as well as the ability to provide anonymous attribute requests for non-identifying Personal Profile attributes (such as
531 zip code).

532 5.5. Use Cases out of scope for ID-WSF, but relevant to later work

533 The Liberty Alliance anticipates that other services will be built on top of the Liberty ID-WSF. Some of these services
534 will be specified within the Alliance context, other services will be proprietary applications built on top of the Liberty

535 ID-WSF architecture. It is anticipated that services such as wallet, calendar, messaging, presence, geo-location and
536 user groups will be useful in conjunction with the Liberty ID-WSF. These services may be formally specified by the
537 Alliance.

References

538

Informative

539

- 540 [RFC1034] Mockapetris, P., eds. (November 1987). "DOMAIN NAMES - CONCEPTS AND FACILITIES," RFC
541 1510, Internet Engineering Task Force <http://www.ietf.org/rfc/rfc1034.txt> [November 1987].
- 542 [RFC2119] Bradner, S., eds. "Key words for use in RFCs to Indicate Requirement Levels," RFC 2119, The Internet
543 Engineering Task Force (March 1997). <http://www.ietf.org/rfc/rfc2119.txt> [March 1997].
- 544 [RFC2222] "Simple Authentication and Security Layer (SASL)," John G. Myers (October 1997). RFC 2222, Internet
545 Engineering Task Force <http://www.ietf.org/rfc/rfc2222.txt> [October 1997].
- 546 [RFC2246] Dierks, T., Allen, C., eds. (January 1999). "The TLS Protocol," Version 1.0 RFC 2246, Internet
547 Engineering Task Force <http://www.ietf.org/rfc/rfc2246.txt> [January 1999].
- 548 [SAMLCore11] Maler, Eve, Mishra, Prateek, Philpott, Rob, eds. (27 May 2003). "Assertions and Protocol
549 for the OASIS Security Assertion Markup Language (SAML) V1.1," OASIS Committee Specification,
550 version 1.1, Organization for the Advancement of Structured Information Standards [http://www.oasis-](http://www.oasis-open.org/committees/documents.php?wg_abbrev=security)
551 [open.org/committees/documents.php?wg_abbrev=security](http://www.oasis-open.org/committees/documents.php?wg_abbrev=security)
- 552 [SOAPv1.1] "Simple Object Access Protocol (SOAP) 1.1," Box, Don, Ehnebuske, David , Kakivaya, Gopal, Layman,
553 Andrew, Mendelsohn, Noah, Nielsen, Henrik Frystyk, Winer, Dave, eds. World Wide Web Consortium W3C
554 Note (08 May 2000). <http://www.w3.org/TR/2000/NOTE-SOAP-20000508/>
- 555 [SOAPv1.2] "SOAP Version 1.2 Part 1: Messaging Framework," Gudgin, Martin, Hadley, Marc, Mendelsohn,
556 Noah, Moreau, Jean-Jacques, Nielsen, Henrik Frystyk, eds. World Wide Web Consortium W3C Proposed
557 Recommendation (07 May 2003). <http://www.w3.org/TR/2003/PR-soap12-part1-20030507/>
- 558 [SSL] Frier, A., Karlton, P., Kocher, P., eds. (November 1996). Netscape Communications Corporation "The SSL 3.0
559 Protocol," <http://www.netscape.com/eng/ssl3/>
- 560 [WSDLv1.1] "Web Services Description Language (WSDL) 1.1," Christensen, Erik, Curbera, Francisco, Meredith,
561 Greg, Weerawarana, Sanjiva, eds. World Wide Web Consortium W3C Note (15 March 2001).
562 <http://www.w3.org/TR/2001/NOTE-wsdl-20010315>
- 563 [wss-sms] Hallam-Baker, Phillip, Kaler, Chris, Monzillo, Ronald, Nadalin, Anthony, eds. (January, 2004). "Web
564 Services Security: SOAP Message Security," OASIS Standard V1.0 [OASIS 200401], Organization for the
565 Advancement of Structured Information Standards [http://docs.oasis-open.org/wss/2004/01/oasis-200401-](http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0.pdf)
566 [wss-soap-message-security-1.0.pdf](http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0.pdf)
- 567 [XML] Bray, Tim, Paoli, Jean, Sperberg-McQueen, C.M., Maler, Eve, eds. (Oct 2000). "Extensible
568 Markup Language (XML) 1.0 (Second Edition)," Recommendation, World Wide Web Consortium
569 <http://www.w3.org/TR/2000/REC-xml-20001006>
- 570 [xmenc-core] Eastlake, Donald, Reagle, Joseph, eds. (December 2002). "XML Encryption Syntax and Processing,"
571 W3C Recommendation, World Wide Web Consortium <http://www.w3.org/TR/xmenc-core/>
- 572 [XMLDsig] Eastlake, Donald, Reagle, Joseph, Solo, David, eds. (12 Feb 2002). "XML-Signature Syntax and
573 Processing," Recommendation, World Wide Web Consortium <http://www.w3.org/TR/xmlsig-core>
- 574 [X.509] "Information technology - Open Systems Interconnection - The Directory: Public-key and attribute certificate
575 frameworks," ITU-T (2000). ITU-T Recommendation X.509 (2000) | ISO/IEC 9594-8:2000,
- 576 [LibertyAuthn] Hodges, Jeff, Aarts, Robert, eds. " Liberty ID-WSF Authentication Service Specification ,"
577 Version 1.1, Liberty Alliance Project (14 December 2004). <http://www.projectliberty.org/specs/>
578 [<http://www.projectliberty.org/specs/>]

-
- 579 [LibertyBindProf] Cantor, Scott, Kemp, John, Champagne, Darryl, eds. "Liberty ID-FF Bindings and
580 Profiles Specification," Version 1.2-errata-v2.0, Liberty Alliance Project (12 September 2004).
581 <http://www.projectliberty.org/specs>
- 582 [LibertyClientProfiles] Aarts, Robert, eds. (14 December 2004). "Liberty ID-WSF Profiles for Liberty enabled User
583 Agents and Devices," version 1.1, Liberty Alliance Project <http://www.projectliberty.org/specs/>
- 584 [LibertyDisco] Sergeant, Jonathan, eds. "Liberty ID-WSF Discovery Service Specification," Version 1.2, Liberty
585 Alliance Project (12 December 2004). <http://www.projectliberty.org/specs>
- 586 [LibertyDST] "Liberty ID-WSF Data Services Template Specification," Version 1.1, Liberty Alliance Project (14
587 December 2004). <http://www.projectliberty.org/specs> Kainulainen, Jukka, Ranganathan, Aravindan, eds.
- 588 [LibertyIDPPP] Kellomaki, Sampo, eds. "Liberty Identity Personal Profile Service Specification," Version 1.0, Liberty
589 Alliance Project (12 November 2003). <http://www.projectliberty.org/specs>
- 590 [LibertyIDWSFGuide] Weitzel, David, eds. (26 April 2004). "Liberty ID-WSF Impelmentation Guideline," Draft
591 version 1.0-08, Liberty Alliance Project <http://www.projectliberty.org/specs/>
- 592 [LibertyInteract] Aarts, Robert, eds. "Liberty ID-WSF Interaction Service Specification," Version 1.1, Liberty Alliance
593 Project (14 December 2004). <http://www.projectliberty.org/specs>
- 594 [LibertyGlossary] "Liberty Technical Glossary," Version 1.4, Liberty Alliance Project (14 Dec 2004).
595 <http://www.projectliberty.org/specs> Hodges, Jeff, eds.
- 596 [LibertyMetadata] Davis, Peter, eds. "Liberty Metadata Description and Discovery Specification," Version 1.1, Liberty
597 Alliance Project (14 December 2004). <http://www.projectliberty.org/specs>
- 598 [LibertyPAOS] Aarts, Robert, eds. "Liberty Reverse HTTP Binding for SOAP Specification," Version 1.1, Liberty
599 Alliance Project (14 December 2004). <http://www.projectliberty.org/specs>
- 600 [LibertyProtSchema] Cantor, Scott, Kemp, John, eds. "Liberty ID-FF Protocols and Schema Specification," Version
601 1.2-errata-v3.0, Liberty Alliance Project (14 December 2004). <http://www.projectliberty.org/specs>
- 602 [LibertySecMech] Ellison, Gary, eds. "Liberty ID-WSF Security Mechanisms," Version 1.2, Liberty Alliance Project
603 (14 December 2004). <http://www.projectliberty.org/specs>
- 604 [LibertySOAPBinding] Hodges, Jeff, Kemp, John, Aarts, Robert, eds. " Liberty ID-WSF SOAP Binding Specification
605 ," Version 1.2, Liberty Alliance Project (14 December 2004). <http://www.projectliberty.org/specs>